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Savannah River Site

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ASSESSMENT & REMEDIATION**

**Interim Record of Decision Amendment for the
Chemicals, Metals, and Pesticides Pits (II) – Ballast Area (U)**

WSRC-RP-2001-4232

Revision 1.1

June 2003

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**Prepared for
U.S. Department of Energy
and
Westinghouse Savannah River Company, LLC
Aiken, South Carolina**

DECLARATION OF INTERIM RECORD OF DECISION AMENDMENT

This document is an Amendment to both the Interim Record of Decision (IROD) for the Chemicals, Metals, and Pesticides (CMP) Pits Interim Remedial Action and the original IROD Amendment. It describes the original planned action, condition changes leading to modifications in the original plan, and proposed modifications to the ongoing Ballast Area interim remedial action. This IROD Amendment was prepared to obtain public input as well as USDOE, USEPA and SCDHEC approval to implement Enhanced Bioremediation as the selected remedy in the Ballast Area.

Initial Remedial Action Originally Planned

The Ballast Area interim remedial action as planned in the IROD (WSRC 1999a) specified clean up of surface soils contaminated with polychlorinated biphenyls (PCBs) and pesticides by excavation, shipment, and off-SRS treatment and disposal. The original estimate for the volume of contaminated soil was 1300 yd³. Approximately 256 yd³ of contaminated soil was excavated.

Conditions that Led to the Changes in the Original Remedial Plan

An IROD Amendment (WSRC 2000b) was approved to cease the interim action in the Ballast Area after 256 yd³ of contaminated soil was excavated because:

1. Forty cubic yards of the excavated soil was found to contain Silvex (a herbicide). Currently no treatment and disposal facilities in the United States can accept Silvex. In addition, Silvex was detected in Ballast Area soils that were slated for excavation. Excavation was stopped until a final disposition for the soils could be identified.
2. Data collected to support the excavation work indicate that the total volume of contaminated soil is in excess of 4000 yd³ based on the old RGs. This is significantly greater than originally estimated.

As part of the IROD Amendment (WSRC 2000b), Enhanced Bioremediation of Ballast Area soil was evaluated in a treatability study. Twelve hundred cubic yards of PCB and pesticide contaminated Ballast Area soil were treated and it was determined that Enhanced Bioremediation is a viable remedial alternative. Enhanced bioremediation is the preferred remedial alternative and constitutes a fundamental change to the original Ballast Area Remedial Alternative (Excavation). The fundamental change warrants this second IROD amendment in accordance with the NCP 300.435(c)(2)(II)(A) though (H)

Subsequently, in support of the final remedial action for the Ballast Area, remedial goals were revised in an RFI/RI Addendum with BRA (WSRC 2002a).

Table 1 provides a summary of the remedial actions specified in the IROD and subsequent amendments.

Table 1 Summary of remedial actions

Document	Interim Record of Decision (IROD)	IROD Amendment	IROD Amendment II
Date of approval	August 12, 1999	September 10, 2001	In process
	<i>Remedial Actions</i>		
Ballast Area	Excavate and dispose off unit	None -Ceased interim action after 256 yd ³ excavated due to waste disposal issue (Silvex) and increase in volume of contaminated soil.	Enhanced Bioremediation -Successfully demonstrated enhanced bioremediation in ballast area treatability study.
Vadose Zone	Soil Vapor Extraction (SVE) with asphalt cover	SVE -Eliminated asphalt cover to allow for additional DNAPL characterization.	SVE -No change from IROD Amendment
Groundwater Hot Spot	Air Sparging (AS) with SVE	None -Eliminated AS due to lower water table.	None -No change from IROD Amendment

Statutory Determinations

Based on the CMP Pits RFI/RI/BRA (WSRC 1997) and RFI/RI Addendum with BRA (WSRC 2002a), the Ballast Area soil poses a risk to human health and the environment.

The revised remedy, in conjunction with the anticipated final remedy, satisfies the statutory requirements in CERCLA Section 121. This revised interim action is protective of human health and the environment, complies with Federal and State applicable or relevant and appropriate requirements for this limited-scope action, and is cost-effective. Although this interim action is not intended to fully address the statutory mandate for permanence and treatment to the maximum extent practicable, this interim action utilizes treatment and thus is in furtherance of that statutory mandate. Because this action does not constitute the final remedy for the CMP Pits OU, the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, although partially addressed in this remedy, will be addressed by the final response action. Subsequent actions are planned to address fully the threats posed by the conditions at the CMP Pits OU. Because this revised remedy will result in hazardous substances remaining on site above HBLs, a review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment within five years after

commencement of the remedial action. Because this is an interim action ROD Amendment, review of this site and of this remedy will be continuing as final remedial alternatives for the CMP Pits OU are developed.”

Proposed Modifications to the Interim Remedial Action

1. Revise remedial goals based on site-specific conditions for pesticides as proposed in the RFI/RI Addendum with BRA (WSRC 2002a). This will reduce the total volume of soil remaining to be remediated from approximately 4500 yd³ to approximately 1000 – 2000 yd³.
2. Implement Enhanced Bioremediation to remediate the remaining Ballast Area soil that is contaminated above revised remedial goals for PCBs and pesticides.

Authorizing Signatures

8/15/03

Date



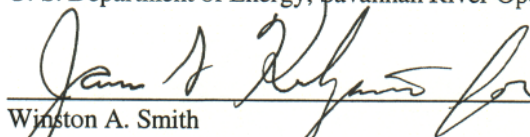
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ACRONYMS AND ABBREVIATIONS

AOC	area of contamination
ARAR	applicable, or relevant and appropriate requirement
AS	air sparging
BRA	baseline risk assessment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CMP Pits	Chemicals, Metals and Pesticides Pits
HL	health-based level
IAPP	Interim Action Proposed Plan
ICMI	Interim Corrective Measures Implementation
IRAO	Interim Remedial Action Objective
IROD	Interim Record of Decision
LDR	land disposal restriction
mg/kg	milligram per kilogram
NCP	National Oil and Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
O&M	operation and maintenance
OSHA	Occupational Safety and Health Act
OU	operable unit
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethylene
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RDR	Remedial Design Report
RFI/RI	RCRA Facility Investigation/Remedial Investigation Report
RG	remedial goal
ROD	Record of Decision
SCDHEC	South Carolina Department of Health and Environmental Control
SCHWMR	South Carolina Hazardous Waste Management Regulations
SRS	Savannah River Site
SVE	soil vapor extraction
TCE	Trichloroethylene
TSCA	Toxic Substance Control Act
US DOE	U.S. Department of Energy
US EPA	U.S. Environmental Protection Agency
WSRC	Westinghouse Savannah River Company, LLC

I. INTRODUCTION AND STATEMENT OF PURPOSE

Savannah River Site

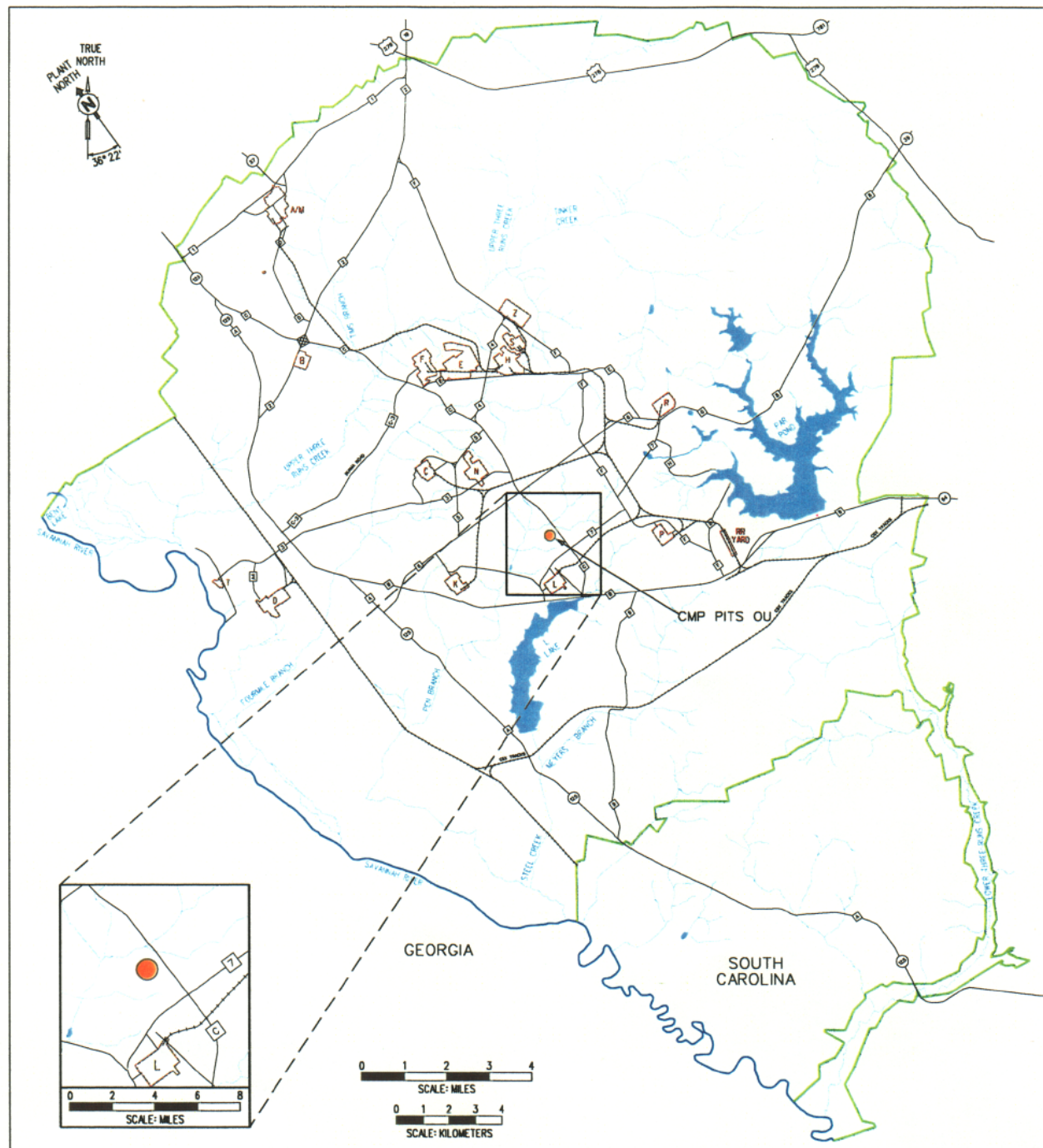
The Savannah River Site (SRS) occupies approximately 310 square miles of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina. The U.S. Department of Energy (US DOE) owns SRS, which is currently managed and operated by Westinghouse Savannah River Company, LLC (WSRC). SRS has historically produced tritium, plutonium, and other special nuclear materials for national defense and the space program. The processes required to meet these needs have produced both chemical and radioactive wastes.

Chemicals, Metals, and Pesticides Pits Location, Description, and Process History

The CMP Pits are located in the central portion of the SRS in Barnwell County more than seven miles from the site boundary (Figure 1). The CMP Pits were identified as a Resource Conservation and Recovery Act/Comprehensive Environmental Response, Compensation and Liability Act (RCRA/CERCLA) unit in 1989. The CMP Pits unit was evaluated through an investigation process that integrates and combines the RCRA Facility Investigation (RFI) process with the CERCLA Remedial Investigation (RI) process to determine the actual or potential impact to human health and the environment.

The CMP Pits Operable Unit (OU) consists of the CMP Pits and soils, Ballast Area soils, and groundwater. When active, the CMP Pits consisted of seven unlined pits, placed in two rows, on top of a knoll. The pits were 10 to 15 feet wide, 45 to 70 feet long, and 10 to 15 feet deep. The Ballast Area, located at the northern edge of the knoll, is an area of soil contamination that extends down the side slope of the knoll for a distance of 20 to 30 feet. The groundwater sub-unit was conceptually separated into two sections for remedial action purposes, the groundwater hot spot and the distal portion of the groundwater plume (distal plume).

Figure 1. Location of CMP Pits OU



Treatability Study

A treatability study in the Ballast Area successfully demonstrated that Enhanced Bioremediation remediated PCB and pesticide contaminated soil (WSRC 2002b). Enhanced Bioremediation is now the preferred remedy for the contaminated soil in the Ballast Area. Since bioremediation was not identified as a remedial alternative in the IROD, it has been determined by the core team to require a fundamental change in the scope and performance of the remedy selected in the IROD. The core team is composed of decision-makers from the U.S. Environmental Protection Agency (US EPA), South Carolina Department of Health and Environmental Control (SCDHEC), and US DOE. This IROD Amendment is necessary to comply with National Oil and Substance Pollution Contingency Plan (NCP) Section 300.435(c)(2)(ii) and CERCLA Section 117. A fundamental change in the selected remedy necessitates issuance of this IROD Amendment as specified in the NCP, Section 300.435(c)(2)(ii). The public will be given the opportunity to review and comment on this IROD Amendment as required by CERCLA §117 as described in Section VIII.

Administrative Record

New information obtained since approval of the original IROD meets the requirements specified to amend the IROD. Information presented in this IROD Amendment will become part of the Administrative Record File in accordance with the requirements of the NCP, Section 300.825(a)(2), because it (1) supports the need to significantly alter the response actions, (2) is not contained elsewhere in the Administrative Record File, and (3) was not available for public review and comment at the time of the comment period for the *Interim Action Proposed Plan for the Chemicals, Metals, and Pesticides (CMP) Pits* (WSRC, 1999b).

The Administrative Record File is available at the following locations:

U. S. Department of Energy Public Reading Room Gregg-Graniteville Library University of South Carolina-Aiken 171 University Parkway Aiken, South Carolina 29801 (803) 641-3465	Thomas Cooper Library Government Documents Department University of South Carolina Columbia, South Carolina 29208 (803) 777-4866
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The RCRA Administrative Record file for SCDHEC is available for review by the public at the following locations:

The South Carolina Department of Health and Environmental Control Bureau of Land and Waste Management 8901 Farrow Road Columbia, South Carolina 29203 (803) 896-4000	Lower Savannah District Environmental Quality Control Office 206 Beaufort Street, Northeast Aiken, South Carolina 29801 (803) 641-7670
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II. CMP PITS OPERABLE UNIT COMPLIANCE HISTORY

CMP Pits Operable Unit Operational History

The CMP Pits, placed into operation in August 1971, were designated to receive chemicals, metals, and pesticides. Formal disposal records were not maintained. Partial disposal records for these pits indicate disposal of trichloroethylene (TCE), tetrachloroethylene (PCE), and pesticides. There is evidence that fluorescent light ballasts, typically filled with heat transfer oil containing polychlorinated biphenyls (PCBs), were disposed during April 1979. The pits were backfilled and closed in December 1979.

SRS initiated a remedial action in 1984 with the concurrence of SCDHEC. The contents of all of the pits were excavated and drums of buried chemicals were removed. However, elevated levels of some constituents remained in the soil. The pits were backfilled in October 1984 with soil believed to be clean and compacted to approximately four feet below the existing ground surface.

PCB-contamination of the Ballast Area soil is believed to be associated with the 1984 removal action. At that time, the contents of the pits were stockpiled in the Ballast Area. The lighting ballasts observed at or near the surface were removed from the area during the characterization activities in 1995. The ballasts were disposed of as potential PCB-contaminated waste material in keeping with all applicable federal, state and local government regulations and guidelines.

Results of the recent investigation performed during the interim action phase indicated that the surface soils at the pits and pits' perimeter areas also have pesticide contamination. Such contamination may be related to soil excavated during the 1984 remedial action and used for backfill in these areas. Those excavated soils were considered as clean fill material at that time.

CMP Pits Operable Unit Compliance History

An RFI/RI characterization and a baseline risk assessment (BRA) were conducted for the unit between 1994 and 1997 (WSRC 1994). The results were presented in the RFI/RI/BRA report (WSRC 1997), and approved by US EPA and SCDHEC in October 1997. An Interim Action Proposed Plan (IAPP) (WSRC 1999b) was approved in March 1999. An IROD (WSRC 1999a) was approved in August 1999, and the interim action began in December 1999. The IROD Amendment (WSRC 2000b), which included ceasing excavation, was approved December 2001. An RFI/RI Addendum with BRA (WSRC 2002a) and a Treatability Study Interim Report (WSRC 2002b) were submitted in October 2002.

III. BASIS FOR THIS IROD AMENDMENT

The basis for this IROD Amendment is 1) new remedial goals are proposed in the RFI/RI Addendum with BRA (WSRC 2002a) and 2) a successful enhanced bioremediation treatability study has been performed in the Ballast Area.

Remedial Goals

The Ballast Area remedial goals were re-evaluated based on site-specific conditions and proposed in the RFI/RI Addendum with BRA (WSRC 2002a). The new remedial goals for ecological risk (Table 2) have changed significantly due to a change in the toxicity reference value (TRV) for DDT and its congeners. The original RGO calculations were based on a TRV for a brown pelican. The use of the brown pelican as the

Table 2 Revised Remedial Goals

COC	Old RG (from RI/BRA) (µg/kg)	New RG (proposed in RI/BRA addendum) (µg/kg)	Future Industrial Worker Risk / Hazard Quotient*	Type of COC
PCBs	1,000	1,000	Risk = 1.35×10^{-6}	ARAR
p,p DDT	60	1,620	HQ = 1	Ecological
p,p DDD	10	287	HQ = 1	Ecological
p,p'-DDE	20	554	HQ = 1	Ecological
Dieldrin	110	68.4	HQ = 1	Ecological
Endrin	60	40	HQ = 1	Ecological
Heptachlor Epoxide	490	21	HQ = 1	Ecological

*Ecological remedial goals are based upon reducing the risk to receptors such that the hazard quotient is less than 1.

surrogate species for an insectivorous bird results in a high degree of uncertainty. The uncertainty is magnified when consideration is given to the bioaccumulation factors of DDT and its metabolites through an aquatic environment. A surrogate species is assumed to represent the species of concern to which it normally has close taxonomic associations. The revised TRV is based on a finch, which is a more appropriate surrogate for the insectivorous bird niche.

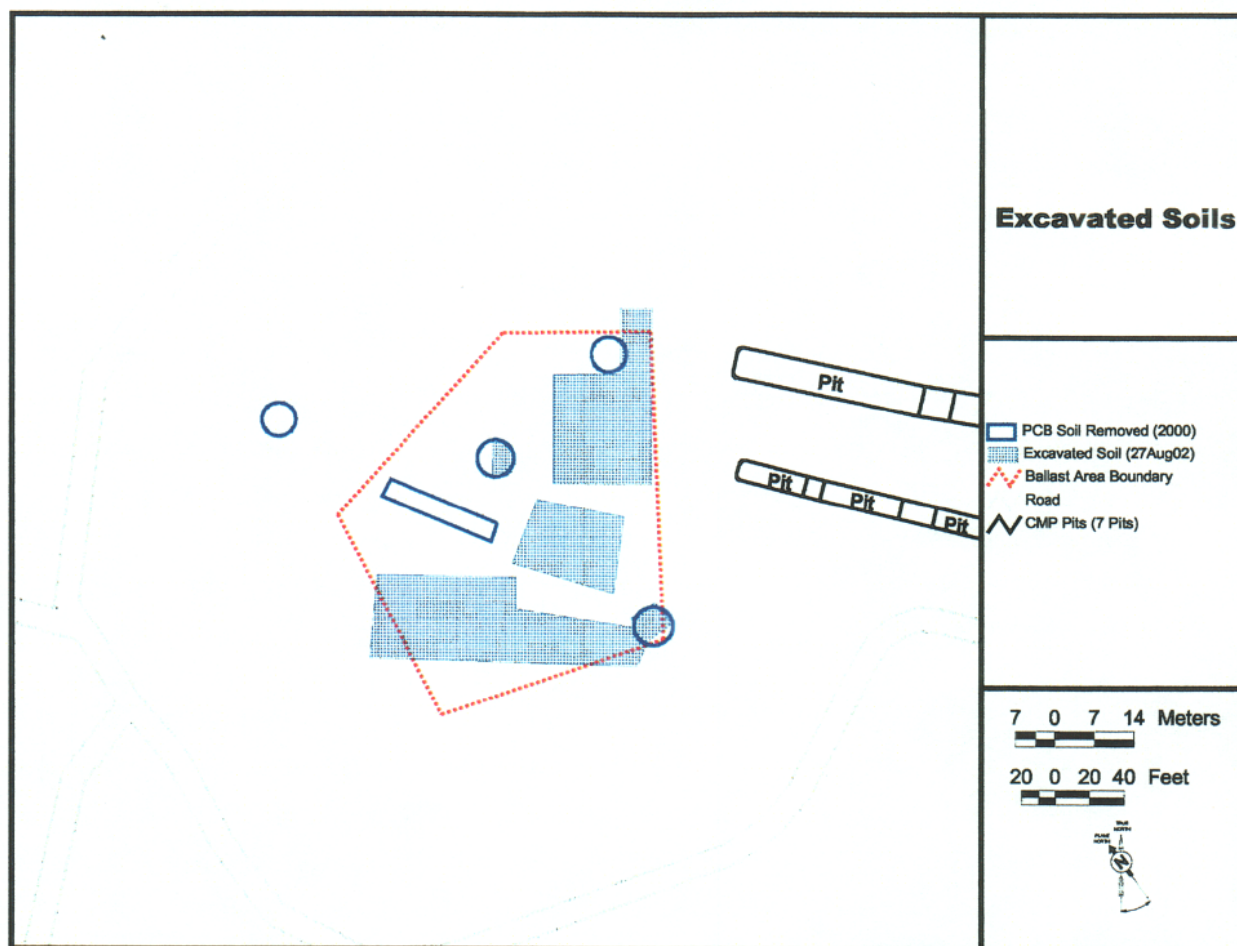
Enhanced Bioremediation

The original Ballast Area interim remedy was to clean up surface soils contaminated with PCBs and pesticides by excavation, shipment, and off-SRS treatment and disposal. Approximately 256 yd³ of pesticide- and PCB-contaminated soil was excavated and containerized in May 2000. Approximately 216 yd³ of excavated soil met the waste acceptance criteria and were shipped for treatment and disposal to a commercial RCRA Subtitle C permitted incinerator, in compliance with the CERCLA Offsite Rule. Waste sampling analysis showed that Silvex (2,4,5-TP), a RCRA listed waste (F027), was present in approximately 40 yd³ of soil in the waste storage area. Excavation and shipping was halted because no RCRA Subtitle C treatment and disposal options for environmental media containing Silvex is currently available in the United States because no incinerator in the U.S. has an approved permit to incinerate wastes containing Silvex. Additional sampling and analysis in two areas confirmed Silvex is present.

Sampling to support the excavation also indicated that the volume of contaminated soil was significantly greater than original estimates. The contaminated soil volume was originally estimated to be 1300 yd³. Data from soil samples collected to support the excavation work indicated that approximately 6000 yd³ would need to be excavated to remove all the soil that is contaminated above remedial goals. Two hundred fifty six cubic yards were shipped and 1200 yd³ were in the treatability study and approximately 4500 yd³ of contaminated soil remains to be remediated. (Figure 2)

Because there are no RCRA treatment or disposal facilities currently available that are permitted to receive the Silvex-contaminated soil, and because of the increase in the estimated volume of contaminated soil, soil excavation was eliminated as part of the interim action. As part of the IROD Amendment to cease excavation in the Ballast Area (WSRC 2000b), alternative remedial actions were investigated.

Figure 2. CMP Pits Operable Unit



The relative location of the CMP Pits and the previously defined boundaries of the Ballast Area are depicted in the figure. The five areas identified by the solid polygons (approximately 256 yd³) were excavated as part of the original interim action. Two hundred sixteen cubic yards were shipped for treatment and disposal and the remaining 40 yd³ were containerized due to the presence of Silvex and incorporated into the treatability study. The cross-hatched areas in the Ballast Area (approximately 1200 yd³) were excavated and used in the treatability study.

Off-site remedial alternatives were not viable options for the Ballast Area soil because of the presence of Silvex. A RCRA Cap was previously evaluated in the CMP Pits IAPP (WSRC-RP-98-4180, March 1999, Revision 1.1) and was determined not to be protective of the future worker involved in the remediation of the vadose zone or the ground water. On-unit remedial alternatives like bioremediation were pursued. Enhanced Bioremediation was selected for further evaluation as part of a treatability study to remediate contaminated Ballast Area soil following a successful bench-scale test as documented in the CMP Pits Treatability Study Work Plan.

A treatability study was performed to determine the effectiveness of enhanced bioremediation on the PCB and pesticide contaminated Ballast Area soil. Since bioremediation was not identified as a remedial alternative in the IROD, it has been determined by the core team to require a fundamental change in the scope and performance of the remedy selected in the IROD. To implement enhanced bioremediation on the remaining soil in the Ballast Area, it is necessary to create this IROD Amendment.

Treatability Study

The treatability study was conducted in two phases of 600 yd³ each. Details of the treatability study with Phase 1 and Phase 2 interim results are documented in the *Treatability Study Interim Report for Enhanced Bioremediation of Soils Contaminated with Pesticides and PCBs at the CMP Pits Ballast Area*, submitted in October 2002. (WSRC 2002) The treatability study successfully demonstrated the viability of enhanced bioremediation at the ballast area. The treatability study results have demonstrated the following:

- The process reduced the COCs to below RGs in all cases for Phases 1 and 2 of the treatability study when the composite sample results for each 600 yd³ are averaged.
- COC concentrations were reduced to less than the new RG levels in nearly all cases. In a few discrete sample cases, the COC levels were not achieved, but would almost certainly get below RG levels in time.
- The process did not produce an accumulation of toxic metabolites.
- Enhanced bioremediation based on horse manure, molasses, appropriate soil amendments and moisture is a process that can be duplicated and can give reproducible results within an acceptable time frame.

- Contract costs for Phase 1 were \$690,000 to remediate 600 yd³ of soil or \$1150/yd³. Because of the increased efficiencies achieved in Phase 2, the same quantity of soil was remediated in three months instead of six for \$350,000 or \$585/yd³. These unit costs are relatively high for enhanced bioremediation and are principally due to the small quantities of soil used in the treatability study and the high cost for the windrow turning machine itself. Full-scale implementation is expected to have much lower costs per cubic yard.

IV. DESCRIPTION OF NEW ALTERNATIVE

Enhanced bioremediation was evaluated in a treatability study and 1200 yd³ of contaminated Ballast Area soil was remediated. Based on the successful treatability study, the remaining Ballast Area soil will be remediated under this amendment. Enhanced Bioremediation will be implemented at the Ballast Area under this interim action in a manner similar to that used during the treatability study. Enhanced Bioremediation will include the following primary activities:

- Construct Windrows – A base (sand pad) will be constructed in a manner similar to that used during the treatability study. Contaminated soil in the Ballast Area will be excavated to a maximum depth of 4 feet and placed into windrows on the base. Baseline sampling will be performed.
- Conduct Enhanced Bioremediation Process – Amendments will be added and soils will be turned to control the aerobic/anaerobic conditions of the windrow. Monitoring and sampling will be performed to assess the progress made during the process and validate that remedial goals have been achieved.
- Treated soil will be placed back on the Ballast Area and a vegetative cover will be established to prevent erosion.

Secondary waste generated as part of the Ballast Area remedial action will be managed consistent with the original IROD Amendment. (WSRC 2000b) WSRC Environmental media and/or secondary waste will be determined to no longer contain listed hazardous waste by direct comparison to the health-based limits.

Waste Management

Environmental media (soil and water) and debris (i.e., lighting ballast) at the CMP Pits contains RCRA listed waste that is subject to applicable RCRA requirements until determined to no longer contain hazardous waste. Environmental media, debris and/or secondary waste will be determined to no longer contain listed hazardous waste by direct comparison to the health-based limits (HBLs) in Table 3.

Table 3. CMP Pits Environmental Media Listed Wastes

Hazardous Contaminant	Waste Code	Soil HBL (mg/kg)	Ground-water HBL (mg/l)	CAS No.
Freon 11 (Trichlorofluoromethane)	F001, F002	390	0.001*	75-69-4
Methylene chloride	F002, U080	8.9	0.001*	75-09-2
TCE (Trichloroethylene)	U228, F001, F002	2.8	0.005	79-01-6
PCE (Tetrachloroethylene)	U210, F001, F002	5.7	0.005	127-18-4
Toluene	U220, F005	520	1.0	108-88-3
Lindane (Gamma-HCH)	U129	0.44	0.002*	58-89-9
Chlordane	U036	0.6 TCLP**	0.002	12789-03-6
Endrin	P051	0.4 TCLP**	0.002	72-20-8
Toxaphene	P123	0.44	0.005	8001-35-2
DDT	U061	1.7	0.002*	50-29-3
DDD	U060	2.4	0.002*	72-54-8
Dieldrin	P037	0.03	0.002*	60-57-1
Heptachlor	P059	0.11	0.002*	76-44-8
Methoxychlor	U247	200 TCLP**	0.04	72-43-5
1,4 Dioxane	U108	44	0.0061	123-91-1
2,4-D (Dichlorophenoxyacetic Acid)	U240	200 TCLP **	0.07	94-75-7
2,4,5-TP (Silvex)	F027	20 TCLP **	0.05	93-72-1
2,4,5-Trichlorophenol	F027	6,100	0.002*	95-95-4
2,4,5-T (Trichlorophenoxyacetic Acid)	F027	610	0.0061	93-76-5

*RCRA MDL used in lieu of MCL

** RCRA toxicity characteristic level used

Soil HBLs in Table 3 are based upon the lower of (1) the EPA Region IX Preliminary Remediation Goals for the residential exposure scenario or (2) the RCRA toxicity characteristic level (due to the 20-fold dilution factor inherent in the TCLP analysis of solids, the RCRA TCLP values are multiplied by 20). Due to analytical method limitations, groundwater (as defined by South Carolina Regulation 61-68) HBLs are based upon the higher of (1) Safe Drinking Water Act MCLs or (2) US EPA RCRA (SW-846) analytical minimum detection levels (MDLs).

Management options for typical wastes anticipated to be generated during the implementation of this IROD Amendment and characterization to support final remediation are contained in Table 4 for waste streams resulting from soil-related activities and Table 5 for waste streams resulting from groundwater-related activities. Consistent with this IROD Amendment, all environmental media will remain uncontainerized on the unit pending completion of the RCRA/CERCLA process.

Changes in the Expected Outcome That Will Result from the IROD Amendment

This amendment to the IROD will result in on-unit treatment of the remaining contaminated Ballast Area soil that exceeds the new proposed RGs (Figure 3). The actual volume of soil to be treated will be determined through extensive sampling during excavation. The goal of the sampling is to restrict treatment to the smallest volume of soil practical. Work to date indicates that the contaminated soil as described by the new proposed RGs is bounded by several polygons that encompass approximately 4500 yd³, but that the distribution of contaminants in the polygons is heterogeneous. It is anticipated that with precision excavation, as little as 1000 - 2000 yd³ of soil may require treatment. The contaminated soil will be remediated to RGs (Table 2) and returned to the Ballast Area.

Post IROD Documentation

An addendum to the Interim Remedial Action Implementation Plan (WSRC 2000a) will be developed to describe the design of the Enhanced Bioremediation at the Ballast Area. Figure 4 illustrates key deliverables and milestones.

Table 4. Contaminated Soil and Secondary Waste Management

Environmental Media	Media Disposal Options	Secondary Waste, Debris, & Equipment	Secondary Waste, Debris & Equipment Disposal Options
Soils Above HBLs (Table 3)	Manage uncontainerized on unit pending final remedial decision	Solids (Note 1)	1) Manage off-unit as hazardous waste; 2) Manage on-unit pending final remediation decision
		Solids Below Soils HBLs After Water Decon	Based on the Contained-In Policy, waste would no longer contain RCRA listed waste and could be disposed as non-hazardous
		Slurries (Note 2)	1) Allow for settling then send to M-1 Stripper; 2) Discharge to contaminated soil stockpile for future treatment; 3) Containerize on-unit pending final remedial decision; 4) Manage off-unit as hazardous waste
		Debris	1) Manage off-unit as RCRA hazardous waste and in accordance with the appropriate disposal regulations; 2) Manage on-unit pending final remediation; 3) Water decon and manage in accordance with the appropriate disposal regulations.
		Equipment/Reusable Items	Water decon and verify below Soils HBLs
Soils Below HBLs (Table 3)	Manage in place on-unit	Solids (Note 1)	Based on Contained-In Policy, waste would no longer contain RCRA listed waste and could be disposed as non-hazardous waste.
		Slurries (Note 2)	Discharge to Ground
		Debris	Dispose as RCRA non-hazardous waste. Manage in accordance with the appropriate disposal regulations.
		Equipment/Reusable Items	Based on Contained-In Policy, equipment would not contain listed waste and will be released for reuse.

Note 1: Solid secondary waste is defined as personal protective equipment (PPE), Soil Vapor Extraction Unit (SVEU) filters, Job Control Waste, etc. This waste may be generated but not limited to the following actions: performing soils, vadose, and saturated unit investigation and SVEU operation.

Note2: Slurries include well installation slurries, well abandonment slurries, and well development water with Total Suspended Solids (TSS) in excess of 100 ppm, decontamination fluids, and condensate from SVEUs.

Table 5. Contaminated Groundwater and Secondary Waste Management

Environmental Media	Media Disposal Options	Secondary Waste, Debris, & Equipment	Secondary Waste, Debris & Equipment Disposal Options
Groundwater Above HBLs (Table 3)	1) Treat at M-1 Stripper; 2) Discharge to contaminated soil stockpile for future treatment; 3) Manage off-unit as a hazardous waste	Solids (Note 3)	1) Manage off-unit as hazardous waste; 2) Manage on-unit pending final remediation decision
		Solids Below Soils HBLs After Water Decon (Note 5)	Based on Contained-In Policy, waste would no longer contain a listed waste and could be disposed as a non-hazardous waste.
		Liquids (Note 4)	1) M-1 Stripper; 2) Discharge to contaminated soil stockpile for future treatment; 3) Containerize on-unit pending final remedial decision; 4) Manage off-unit as hazardous waste
		Equipment/Reusable Items	Water decon and verify below Soils HBLs (Note 5).
Groundwater Below HBLs (Table 3)	Discharge to the ground	Solids (Note 3)	Based on Contained-In Policy, waste would no longer contain RCRA listed waste and could be disposed as non-hazardous waste.
		Liquids (Note 4)	Discharge to Ground
		Equipment/Reusable Items	Based on Contained-In Policy, equipment would not contain listed waste and will be released for reuse.

Note 3: Solid secondary waste is defined as personal protective equipment (PPE), Job Control Waste, etc. This waste may be generated but not limited to the following actions: groundwater sampling and characterization.

Note 4: Liquid secondary waste is defined as purgewater generated while performing groundwater sampling and characterization; well development water where Total Suspended Solids (TSS) is less than 100 ppm.

Note 5: Decon water will be treated and disposed at an acceptable SRS treatment facility (e.g., M-1 Stripper, ETF, or CMP contaminated soil stockpile).

Figure 3. Areas within the Ballast Area which Exceed New Proposed Remedial Goals

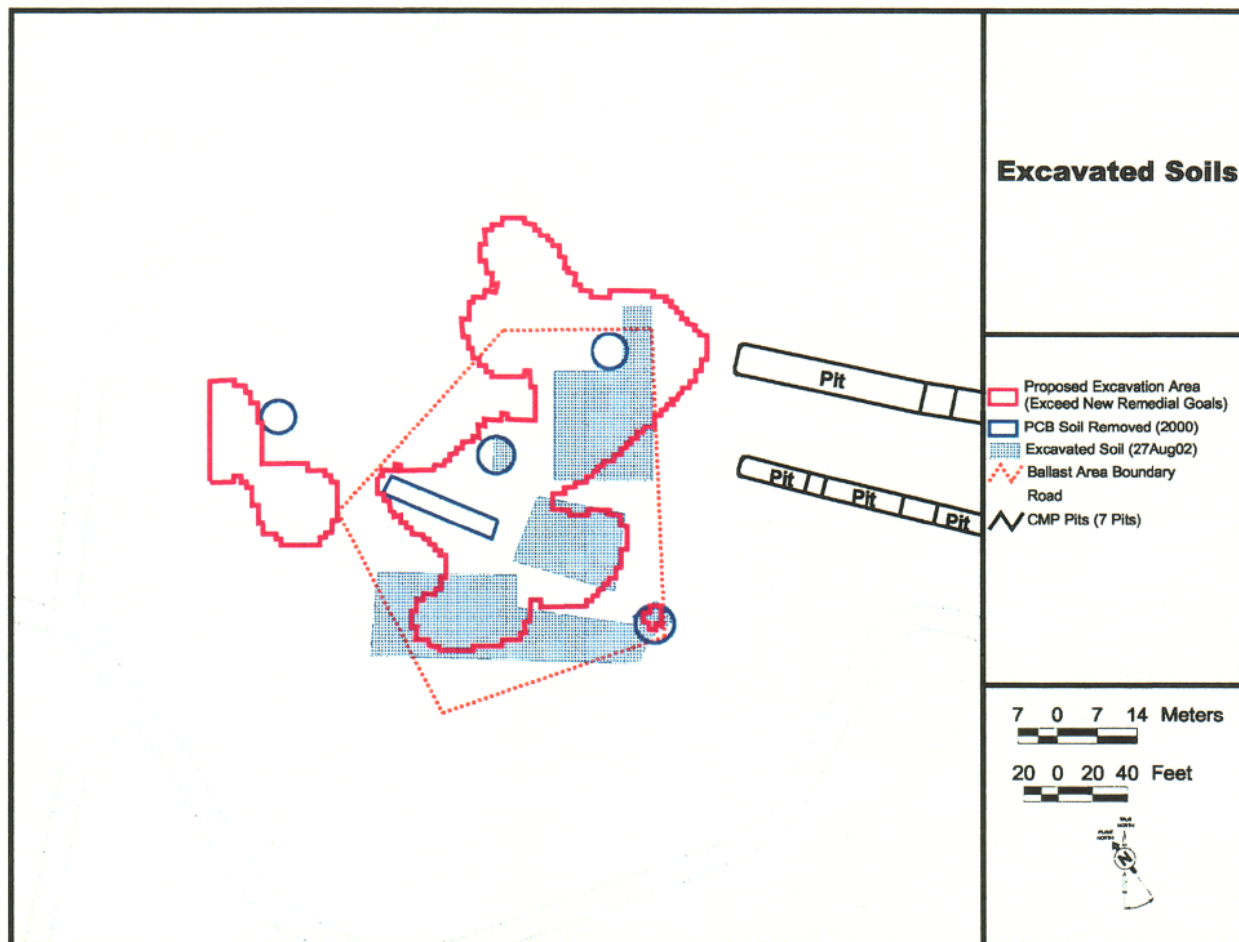


Figure 4. Implementation Schedule

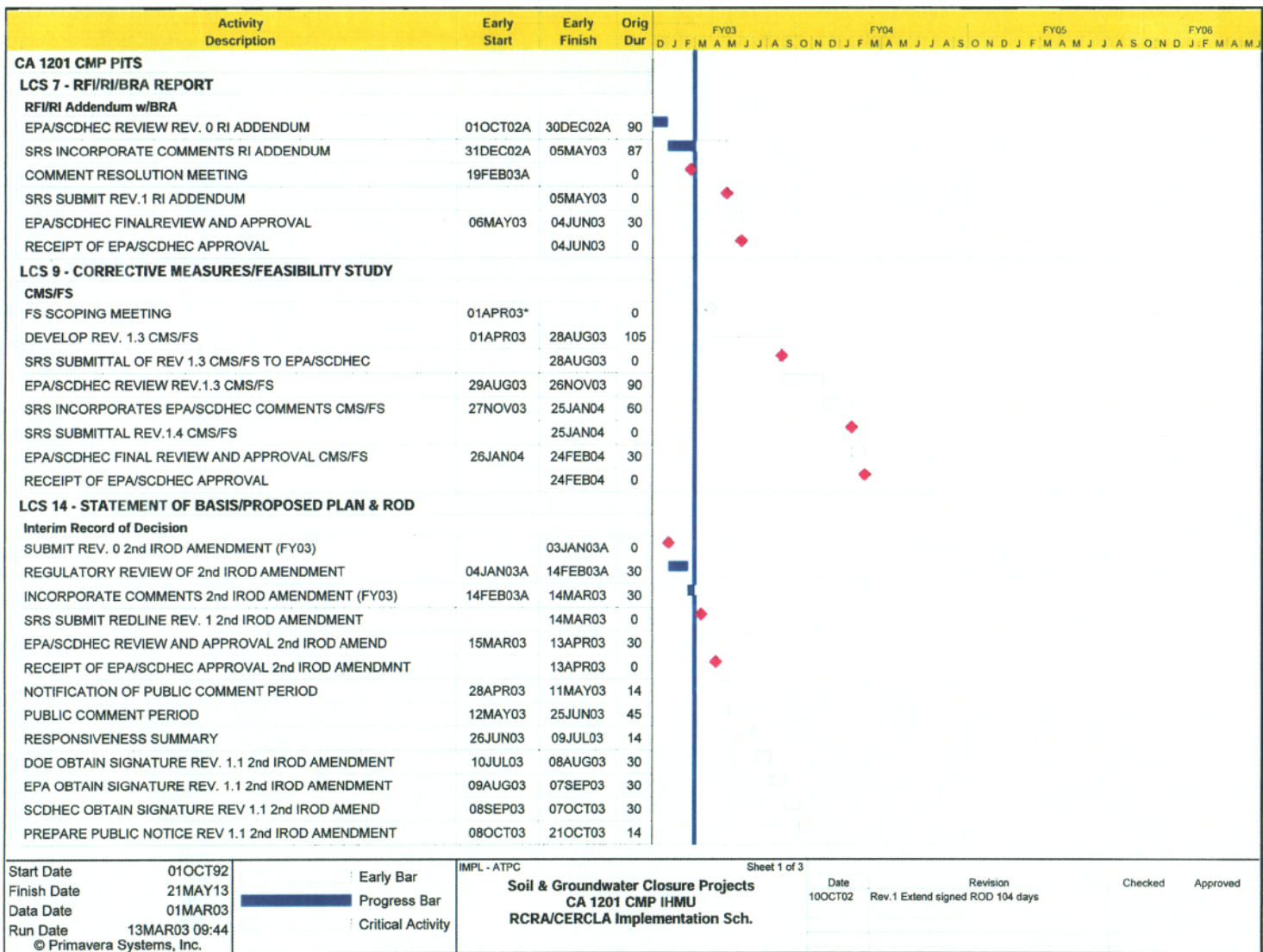
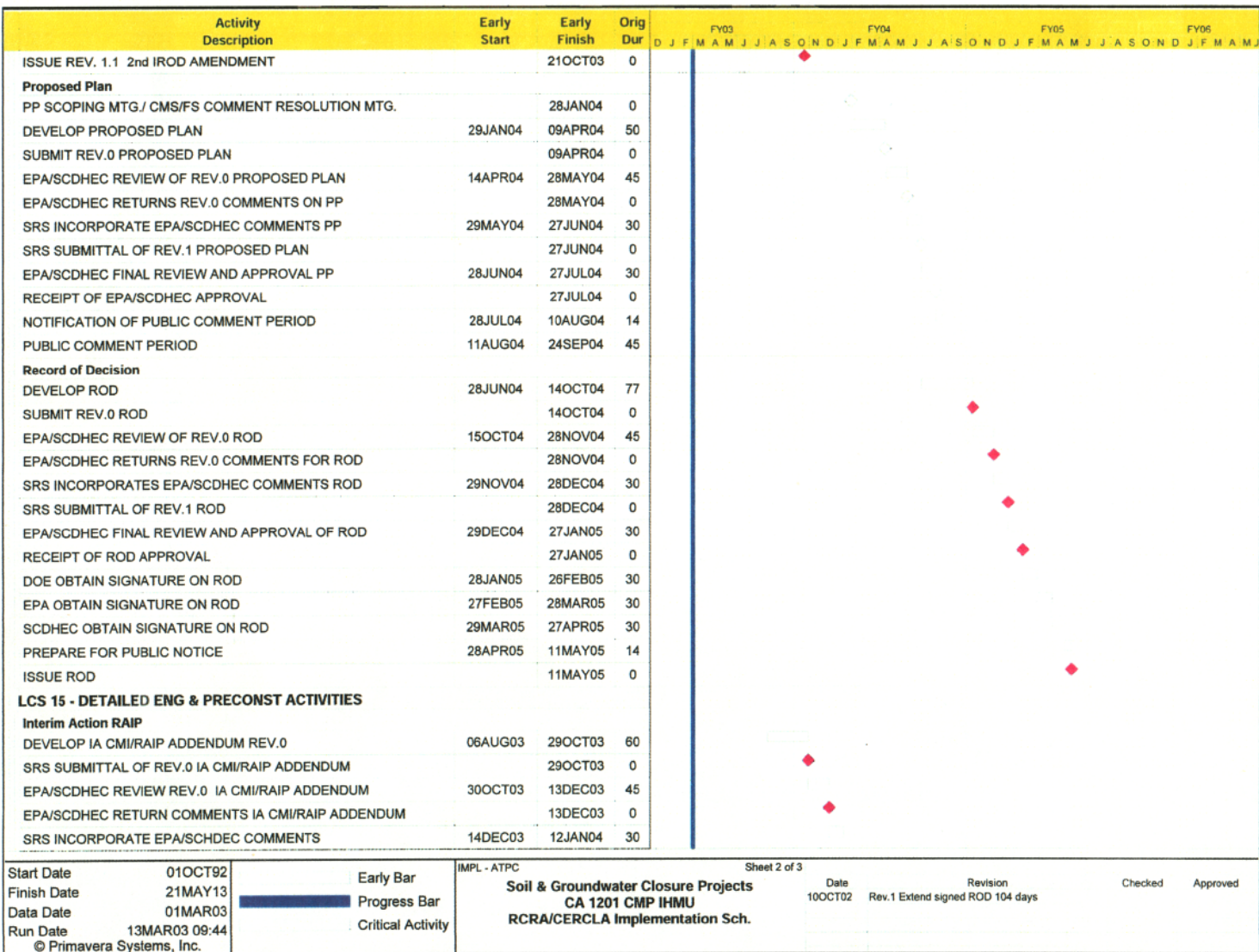


Figure 4. Implementation Schedule (Continued)



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V. EVALUATION OF ALTERNATIVES

Evaluation Criteria

In selecting the IROD remedy, nine criteria derived from the statutory requirements of CERCLA Section 121 were used to evaluate and compare the interim remedy approved in the IROD (WSRC 1999a) and the revised remedy presented in this IROD Amendment. Seven of the criteria are used to evaluate all alternatives, based on human health and environmental protection, cost, feasibility, and implementability issues. Comparative evaluations of all the remedial action alternatives against these seven criteria are detailed in the IAPP (WSRC 1999a). The selected interim remedy was further evaluated based on the final two criteria: state acceptance and community acceptance. The criteria are as follows:

- Overall Protection of Human Health and the Environment
- Compliance with applicable or relevant and appropriate requirements (ARARs)
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

Comparative Alternative Analysis

The interim remedy and the revised remedy were evaluated against the nine criteria and their effectiveness in meeting IRAOs. The action-specific, chemical-specific, and location-specific ARARs are shown in Table 6. Key ARARs are highlighted in Table 6. The summary of this evaluation for the revised interim remedy is presented in Table 7. Cost information is provided in Appendix A.

Table 6. Chemical-, Action-, Location- Specific ARARs

Citation(s)	Status	Requirement Summary	Reason for Inclusion
Chemical			
40 CFR 261 and SC R. 61-79.261 Identification and Listing of RCRA Hazardous Waste	Applicable	Defines criteria for determining whether a waste is RCRA hazardous waste.	All waste media that are actively managed must be tested to determine if they are RCRA characteristic wastes. Discarded pesticides and chemicals are RCRA listed hazardous wastes.
40 CFR 268 Land Disposal Restrictions (LDRs) (RCRA)	Applicable	Prohibits land disposal and specifies treatment standards for specific RCRA hazardous wastes outside the area of concern (AOC). In accordance with USEPA AOC policy (63F.R.65.874) an exclusion to this citation exists for placement within the AOC.	Movement of excavated materials from their original location outside of the area of concern (Figure 5) triggers the RCRA LDRs. Pesticides and solvents are RCRA listed wastes.
40 CFR 761, (TSCA) (I)	Relevant and Appropriate	Identifies cleanup levels and disposal requirements for cleaning, decontaminating, or removing PCB remediation waste.	§761.61(a)(4)(I)(A) identifies <1mg/kg as the cleanup level for high occupancy areas without further conditions. Requirements for water are in §761.79(b)(1). Disposal requirements specified in §761.61(a)(5)(i)(B)(2)(ii), §761.61(a)(5)(i)(B)(2)(iii) or §761.61(b)(2)(i). EPA-IV policy consistent with §761.61(c) allows storage of containerized/packaged PCB bulk remediation waste up to 180 days from containerization within AOC.
Action			
40 CFR 50.6, Federal Air Regulations	Applicable	The concentration of particulate matter (PM ₁₀) in ambient air shall not exceed 50 µg/m ³ (annual arithmetic mean) or 150 µg/m ³ (24-hour average concentration).	Earth-moving activities will generate airborne dust that will have the potential to exceed the levels specified. Dust suppression will likely be required to minimize dust emissions.
SC R.61-9 NPDES Permits	Applicable	Requires notification of intent to discharge storm water from construction associated with industrial activity that will result in a land disturbance of 5 acres or more and/or industrial activities and sets the requirements for the control of storm water discharges	Potentially applicable if stormwater is discharged during construction activities.
SC R.61-62.6 Fugitive Dust	Applicable	Fugitive particulate material shall be controlled	Construction activities shall minimize fugitive particulate emissions. Earth-moving activities have the potential to generate airborne particulate matter
SC R.72-300 Standards for Stormwater Management and Sediment Reduction.	Applicable	Stormwater management and sediment control plan for land disturbances	Excavation activities require an erosion control plan.
29 CFR 1910 Occupational Worker Safety (OSHA)	Applicable	Identifies health and safety requirements for remediation workers.	Worker activities involving hazardous materials must be conducted according to a project health and safety plan.

Table 6. Chemical-, Action-, Location- Specific ARARs (Continued)

Location			
16 USC 703	Applicable	The remedial action must be conducted in a manner that minimizes impacts to migratory birds and their habitats.	Migratory bird populations may be present in the vicinity of the SRS.
Executive Order 11990	Applicable	The remedial action must minimize the destruction, loss, or degradation of wetlands.	Wetlands are located in the vicinity of the CMP Pits; however, they will be unaffected by this action.

Note 1. Key ARARs are highlighted in bold type.

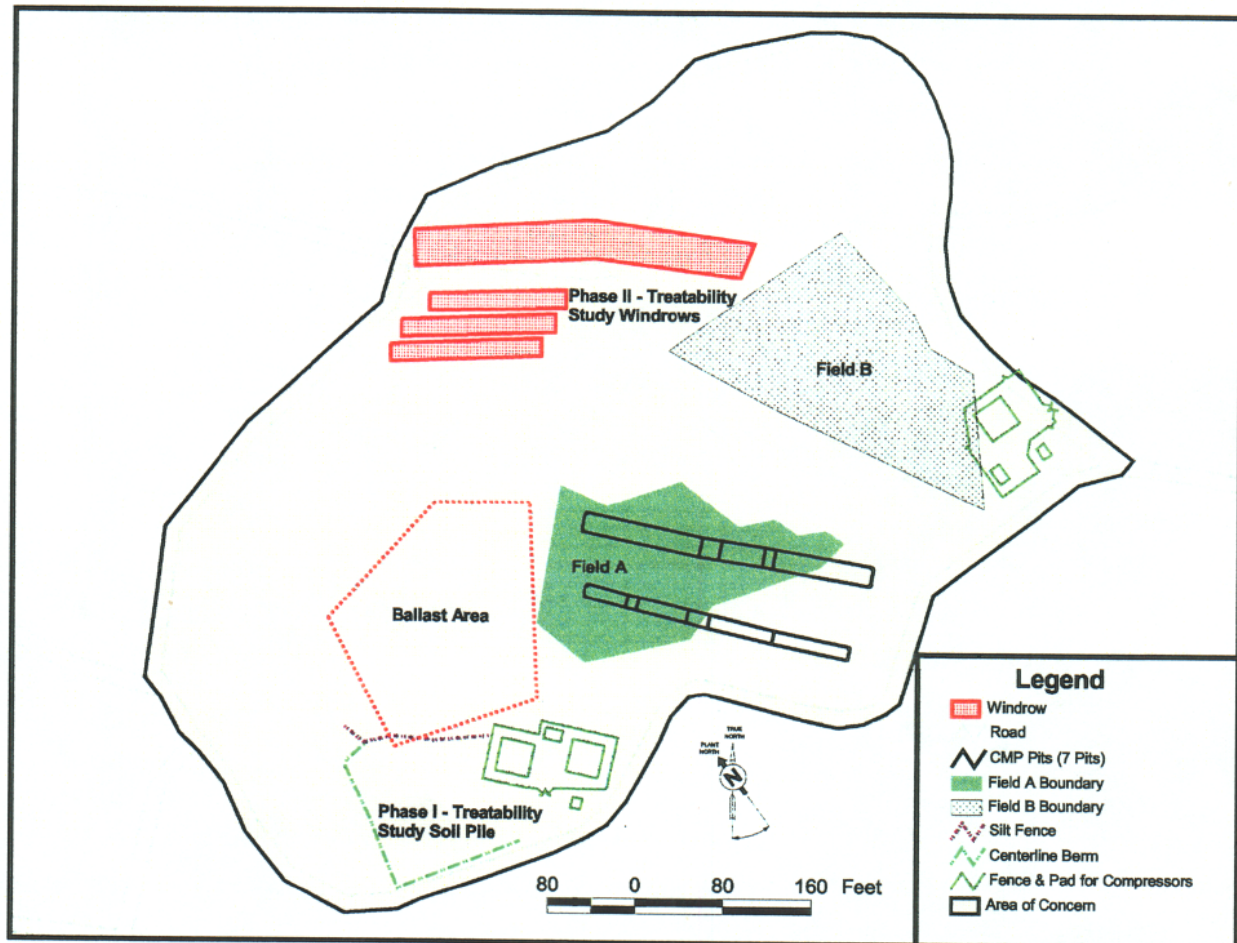
Table 7. Summary of the Ballast Area Remedy Evaluation

Comparative Alternative Analysis for the Ballast Area Subsurface Soils		
Criterion	IROD Remedy Excavation/Disposal	Revised Remedy Enhanced Bioremediation
Overall Protection of Human Health and the Environment		
Human Health	Protective	Protective
Environment	Protective	Protective
Control of Source Release	Controlled	Controlled
Compliance with ARARs		
Chemical-specific	Meets ARARs, TSCA, Disposal of PCBs High Occupancy, and RGs without further conditions.	Meets ARARs, TSCA, Disposal of PCBs High Occupancy, and RGs without further conditions for treated soil.
Location-specific	N/A	N/A
Action-specific	Does not meet ARARs. RCRA regulation for hazardous waste treatment not met.	Meets ARARs
Long Term Effectiveness and Permanence		
Magnitude of residual risks	Human Health and Ecological RGs met, no land use control required.	Human health and ecological goals met for treated soil. Land use controls for remaining soil in Ballast Area
Adequacy of controls	Adequate	Adequate with land use controls
Permanence	Permanent	Permanent for treated soil
Reduction of Toxicity, Mobility, or Volume through Treatment		
Treatment process used and materials treated	PCB- and pesticide-contaminated soil to be incinerated.	PCB and pesticide – contaminated soil to be bioremediated
Degree of expected reduction in toxicity, mobility, or volume	Excavation would remove soil contamination above original RGs	Bioremediation to treat soil contamination above revised RGs
Amount of hazardous materials destroyed or treated	Would treat 4500 yd ³ of Ballast Area soil	Would treat approximately 1000 - 2000 yd ³ Ballast Area soil and destroy contaminants
Degree to which treatment is irreversible	Contaminant removal and treatment are irreversible	Contaminant removal and treatment are irreversible
Types and quantities of residuals remaining after treatment	Sampling derived waste (minor volumes)	Sampling derived waste (minor volumes)

Table 7. Summary of the Ballast Area Remedy Evaluation (Continued)

Comparative Alternative Analysis for the Ballast Area Subsurface Soils		
Criterion	IROD Remedy Excavation/Disposal	Revised Remedy Enhanced Bioremediation
Short-term effectiveness		
Risks to workers	Moderate; potential risk due to inhalation or direct contact during soil excavation; disturbance and handling of contaminated soil; OSHA and applicable work safety and health regulations will be followed	Moderate; potential risk due to inhalation or direct contact during soil excavation; disturbance and handling of contaminated soil; OSHA and applicable work safety and health regulations will be followed
Risk to community	Minimal; off-site transport of contaminated soil	None
Risk to environment	Moderate; potential risk due to soil erosion during Ballast Area excavation; spills during off-site transport and disposal of soils	Moderate potential risk due to soil erosion during Ballast Area excavation
Time to achieve remedial action objectives	24 months	24 months
Implementability		
Availability of materials, equipment, contractors	Equipment available to excavate contaminated soil. No incinerator permitted for Silvex.	Equipment available to treat remaining contaminated soil
Ability to construct and operate the technology	Well demonstrated and commonly used technologies	Technology demonstrated at Ballast Area
Ability to obtain permits/approvals from other agencies	Not implementable. Treatment of soils containing Silvex is not permitted.	Implementable
Ability to monitor effectiveness of remedy	Implementable; soil screening required during excavation	Implementable
Ease of undertaking additional actions (if required)	Compatible	Compatible
Time to implement	9 months	24 months
Cost		
Present Worth Capital Cost	\$4,600,000	\$3,302,000
Present Worth O&M Cost	\$0	\$130,000
Total Present Worth Cost	\$4,600,000 (based on 4500 yd ³)	\$3,432,000 (based on 2000 yd ³)

Figure 5. CMP Pits Area of Concern



The original selected interim remedy for the Ballast Area in the IROD, Excavation/Disposal of Ballast Area soil, was determined to be protective of human health and the environment since it removed the PCB- and pesticide- contaminated soil. Because the total area of contamination has been reduced as a result of the Excavation/Disposal, the exposure potential and the opportunities for bio-uptake and stormwater runoff have been reduced. Enhanced Bioremediation of Ballast Area soil will further reduce risk to human health and the environment.

State Acceptance

SCDHEC and US EPA concurrence with the proposed revised interim action is pending.

Community Acceptance

Community acceptance of the revised interim remedy was assessed by giving the public an opportunity to comment on the IROD Amendment during the public comment period (May 9, 2003 – June 22, 2003). No public comments were received.

VI. SUPPORT AGENCY COMMENTS

Given the significant changes between the original interim remedy and the revised interim remedy, US EPA and SCDHEC recommended that an IROD Amendment (as opposed to an Explanation of Significant Differences or other document) be used to document the revised remedy decision.

VII. STATUTORY DETERMINATIONS

Based on the CMP Pits RFI/RI/BRA (WSRC 1997) and RFI/RI Addendum with BRA (WSRC 2002a), the Ballast Area soil poses a risk to human health and the environment.

The revised remedy, in conjunction with the anticipated final remedy, satisfies the statutory requirements in CERCLA Section 121. This revised interim action is protective of human health and the environment, complies with Federal and State applicable or relevant and appropriate requirements for this limited-scope action, and is cost-effective. Although this interim action is not intended to fully address the statutory mandate for permanence and treatment to the maximum extent practicable, this interim action utilizes treatment and thus is in furtherance of that statutory mandate. Because this action does not constitute the final remedy for the CMP Pits OU, the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, although partially addressed in this remedy, will be

addressed by the final response action. Subsequent actions are planned to address fully the threats posed by the conditions at the CMP Pits OU. Because this revised remedy will result in hazardous substances remaining on site above HBLs, a review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment within five years after commencement of the remedial action. Because this is an interim action ROD Amendment, review of this site and of this remedy will be continuing as final remedial alternatives for the CMP Pits OU are developed.

VIII. PUBLIC PARTICIPATION COMPLIANCE

Both RCRA and CERCLA require that the public receive an opportunity to review and comment on the proposed interim remedial alternative. Public participation requirements, listed in South Carolina Hazardous Waste Management Regulation (SCHWMR) R.61-79.124 and in CERCLA, Sections 113 and 117, include establishment of an administrative record file at or near the facility at issue. The file documents the investigation and selection of the remedial alternatives for addressing the CMP Pits.

The SRS Public Involvement Plan (US DOE 1994) addresses RCRA, CERCLA, and National Environmental Policy Act (NEPA) requirements and supports public involvement in the decision-making process for permitting, closure, and the selection of remedial alternatives. SCHWMR R.61-79.124 and CERCLA Section 117(a), as amended, require the advertisement of the draft permit modification, if needed, and notice of any proposed remedial action and provide the public an opportunity to participate in the selection of the remedial action. The IAPP (WSRC 1999b), a part of the administrative record file, highlights key aspects of the investigation and identifies the preferred action for addressing the CMP Pits. A 30-day public comment period for the IAPP began March 15, 1999 and ended April 13, 1999. The IAPP was presented to the SRS Citizen Advisory Board in open public meetings on March 22 and 23, 1999. A Responsiveness Summary was prepared to address comments received during the public comment period. The Responsiveness Summary was included in Appendix A of the IROD (WSRC 1999a).

This IROD Amendment was made available for public comment and review as specified in the SRS Public Involvement Plan (US DOE 1994). No public comments were received. An IAPP, normally prepared to facilitate public participation, was not required because this IROD amendment was made available for public comment and the other Ballast Area remedial alternatives were made available previously for public comment (WSRC 1999b).

IX. REFERENCES

US DOE, 1994. *Public Involvement, A Plan for the Savannah River Site*, Savannah River Operations Office, Aiken, South Carolina.

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WSRC, 1997. *RCRA Facility Investigation/Remedial Investigation Report with Baseline Risk Assessment for the Chemicals, Metals and Pesticides (CMP) Pits (080-17G, 080-17.1G, 080-18.1G, 080-18.2G, 080-18.3G, & 080-19G) (U)*, Volumes I and II, WSRC-RP-96-00112, Revision 1.2, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina, (August).

WSRC, 1999a. *Interim Record of Decision Remedial Action Alternative Selection for the Chemicals, Metals and Pesticides Pits (080-17G, 080-17.1G, 080-18G, 080-18.1G, 080-18.2G, 080-18.3G, 080-19G) (U)*, WSRC-RP-98-4192, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina, (August).

WSRC, 1999b. *Interim Action Proposed Plan for the Chemicals, Metals and Pesticides (CMP) Pits (U)*, WSRC-RP-98-4130, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina, (March).

WSRC, 2000a. *Interim Corrective Measures Implementation/Remedial Design/Remedial Design Report/Remedial Action Work Plan for Chemicals, Metals, and Pesticides (CMP) Pits Operable Unit (080-17G, 080-17.1G, 080-18G, 080-18.1G, 080-18.2G, 080-18.3G, 080-19G) (U)*, WSRC-RP-99-00332, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina, (January).

WSRC, 2000b. *Interim Record of Decision Amendment for the Chemicals, Metals, and Pesticides Pits (080-170G, 080-171G, 080-180G, 080-181G, 080-182G, 080-183G, 080-190G) (U)*, WSRC-RP-2000-4158, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina, (July).

WSRC, 2001. *Chemicals, Metals, and Pesticides Pits Operable Unit Data Gap Sampling and Analysis Plan*, WSRC-RP-2001-4062, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina, (April).

WSRC, 2002a. *RCRA Facility Investigation/Remedial Investigation Addendum with Baseline Risk Assessment for the CMP Pits (U)*, WSRC-RP-2002-4049, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina, (October).

WSRC, 2002b. *Treatability Study Interim Report for Enhanced Bioremediation of Soils Contaminated with Pesticides and PCBs at the CMP Pits Ballast Area (U)*, WSRC-RP-2002-4184, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina, (October).

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Appendix A – CMP Pits – Ballast Area Interim Remedial Action Present Worth Cost

General Requirements	Quantity	Units	Cost / Unit	Total	Grand Total
Submittals	1	LS	\$25,000.00	\$25,000	
Temporary Controls/Miscellaneous Items	1	LS	\$135,000.00	\$135,000	
Technical Requirements	1	LS	\$260,000.00	\$260,000	
Dust Suppression	24	MO	\$1,100.00	\$26,400	
Total General Requirements				\$446,400	\$446,400
Develop Windrows					
Construct Windrows (including excavation of soil)	1	LS	\$195,942.00	\$195,942	
Plastic	32,000	SF	\$0.60	\$19,200	
Silt Fence	4,000	LF	\$0.50	\$2,000	
Mobilization and Demobilization of Large Equipment	4.0	EA	\$843.80	\$3,375	
Dump Trucks (2)	953	HR	\$23.84	\$22,720	
Backhoe	490	HR	\$8.83	\$4,327	
Tractor	490	HR	\$6.21	\$3,043	
Dozer	490	HR	\$22.45	\$11,001	
Total Develop Windrows				\$261,607	\$261,607
Sampling - Windrow Construction					
Soil Sampling					
Subcontract Soil Sample Collection	400	Samples	\$ 200.00	\$80,000	
Technical Oversight	400	Samples	\$ 53.00	\$21,200	
Technical Oversight Sampling Report	1	LS	\$ 1,500.00	\$1,500	
Construction Engineering Support	400	Samples	\$ 65.07	\$26,028	
Soil Sample Analysis					
Pesticides, PCBs	400	Samples	\$ 252.00	\$100,800	
Herbicides	240	Samples	\$ 190.00	\$45,600	
Volatiles	80	Samples	\$ 150.00	\$12,000	
Semivolatiles	80	Samples	\$ 315.00	\$25,200	
Soil Sample Data Review and Interpretation	1	LS	\$ 150,552.00	\$150,552	
Total Sampling - Windrow Construction				\$462,880	\$462,880
Sampling - Excavated Area					
Soil Sampling					
Construction Survey - Exempt	120	Samples	\$ 130.14	\$15,617	
Construction Survey - Nonexempt	120	Samples	\$ 33.60	\$4,032	
Subcontract Soil Sample Collection	120	Samples	\$ 200.00	\$24,000	
Technical Oversight	120	Samples	\$ 53.00	\$6,360	
Technical Oversight Sampling Report	1	LS	\$ 1,500.00	\$1,500	
Construction Engineering Support	120	Samples	\$ 65.07	\$7,808	
Soil Sample Analysis					
Pesticides, PCBs	120	Samples	\$ 252.00	\$30,240	
Soil Sample Data Review and Interpretation	1	LS	\$ 12,096.00	\$12,096	
Total Sampling - Excavated Area				\$101,653	\$101,653
Enhanced Bio-Remediation					
Subcontract	2,000	CY	\$400.00	\$800,000	
Remove Plastic and Tarps	32,000	sf	\$0.29	\$9,280	
Haul Material to Land Fill site	1,000	CY	\$20.09	\$20,090	
Waste Disposal Cost	810	Ton	\$25.75	\$20,858	
Total Enhanced Bioremediation				\$850,228	\$850,228
Other Items					
Preliminary Engineering	1	LS	\$30,000.00	\$30,000	
Detailed Engineering & Preconstruction	1	LS	\$180,000.00	\$180,000	
Project Support for Remedial Design	1	LS	\$130,000.00	\$130,000	
Remediation Derived Waste	1	LS	\$12,000.00	\$12,000	
Project Support for Construction	1	LS	\$55,000.00	\$55,000	
Title III Support	1	LS	\$68,000.00	\$68,000	
Final Action Report	1	LS	\$15,000.00	\$15,000	
Post Construction Activities	1	LS	\$45,000.00	\$45,000	
Project Support for Post Construction	1	LS	\$14,000.00	\$14,000	
Project Support for Remedial Action Phase	1	LS	\$80,000.00	\$80,000	
Total Other Items				\$629,000	\$629,000
Contingency Allowance (20%)					\$550,354
Total Capital Cost					\$3,302,121

Appendix A – CMP Pits – Ballast Area Interim Remedial Action Present Worth Cost (Continued)

CMP Pits - Ballast Area Interim Remedial Action Operations and Maintenance Costs

	Quantity	Units	Cost/Unit	Total
Inspection (semi-annual)	2	60,000ft ²	\$ 500	\$ 1,000
Subsidence Monitoring	2	60,000ft ²	\$ 200	\$ 400
Mowing (semi-annual)	2	60,000ft ²	\$ 1,500	\$ 3,000
Repair	2	60,000ft ²	\$ 1,500	\$ 3,000
Total Annual O&M Cost				\$ 7,400

Summary of Present Worth Analysis

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (3.9%)	Present Worth
0	\$3,302,121		\$ 3,302,121	1.000	\$ 3,302,121
1		\$ 7,400	\$ 7,400	0.962	\$ 7,122
2		\$ 7,400	\$ 7,400	0.926	\$ 6,855
3		\$ 7,400	\$ 7,400	0.892	\$ 6,598
4		\$ 7,400	\$ 7,400	0.858	\$ 6,350
5		\$ 7,400	\$ 7,400	0.826	\$ 6,112
6		\$ 7,400	\$ 7,400	0.795	\$ 5,882
7		\$ 7,400	\$ 7,400	0.765	\$ 5,661
8		\$ 7,400	\$ 7,400	0.736	\$ 5,449
9		\$ 7,400	\$ 7,400	0.709	\$ 5,244
10		\$ 7,400	\$ 7,400	0.682	\$ 5,047
11		\$ 7,400	\$ 7,400	0.656	\$ 4,858
12		\$ 7,400	\$ 7,400	0.632	\$ 4,676
13		\$ 7,400	\$ 7,400	0.608	\$ 4,500
14		\$ 7,400	\$ 7,400	0.585	\$ 4,331
15		\$ 7,400	\$ 7,400	0.563	\$ 4,169
16		\$ 7,400	\$ 7,400	0.542	\$ 4,012
17		\$ 7,400	\$ 7,400	0.522	\$ 3,862
18		\$ 7,400	\$ 7,400	0.502	\$ 3,717
19		\$ 7,400	\$ 7,400	0.483	\$ 3,577
20		\$ 7,400	\$ 7,400	0.465	\$ 3,443
21		\$ 7,400	\$ 7,400	0.448	\$ 3,314
22		\$ 7,400	\$ 7,400	0.431	\$ 3,189
23		\$ 7,400	\$ 7,400	0.415	\$ 3,070
24		\$ 7,400	\$ 7,400	0.399	\$ 2,954
25		\$ 7,400	\$ 7,400	0.384	\$ 2,843
26		\$ 7,400	\$ 7,400	0.370	\$ 2,737
27		\$ 7,400	\$ 7,400	0.356	\$ 2,634
28		\$ 7,400	\$ 7,400	0.343	\$ 2,535
29		\$ 7,400	\$ 7,400	0.330	\$ 2,440
30		\$ 7,400	\$ 7,400	0.317	\$ 2,348
Totals	\$ 3,302,121.02	\$ 222,000	\$ 3,524,121		\$ 3,431,650

Total Present Worth Cost \$ 3,431,650

Notes:

Capital cost estimates are not discounted because the construction work will be performed in the first year. O&M costs are reported as present worth estimates given a 5% discount rate for a 30 year duration. Cost estimates are based on soil volume estimates which are based on a conceptual design. Cost estimates are within +50% to -30% accuracy expectation.

CY=Cubic Yard
EA=Each
HR=Hours
LS=Lump sum
LF=Linear Foot
M=Meter
MO=Month
MSF=Thousand Square Feet
SY=Square Yard